AVALON RF

Wireless Solutions
For Audio & Video Links

DX404 / DX504 / DX604 Four Antenna Diversity Receivers

User's Guide & Operating Manual

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1.   General

The DX404/DX504/DX604 are rugged 4-antenna 'true' diversity video and audio receivers intended for demanding high end video applications.

The DX404 NTSC model tuning range is from 56MHz to 802.25MHz
The DX404 PAL model tuning range is from 56MHz to 860MHz.
The DX504 tuning range is from 900 MHz to 2150 MHz.
The DX604 tuning range is from 2350 MHz to 2500 MHz.

All receivers have the following standard feature:

One FM modulated video channel
Two FM modulated audio channels

And the following optional features:

Broadcasting industry options
* SMPTE/VITC Time stamp
* Talk back audio channel
* Remote control of the receiver via RS232

Security industry options
* SMPTE/VITC time stamp & watermarking
* Serial communication input port for Pan/Tilt/Zoom control
* Alarm output
* Four output analog telemetry

Unless explicitly stated, every reference in this document to the DX604 also implies the DX404 and DX504. The main difference between the models is the frequency range.
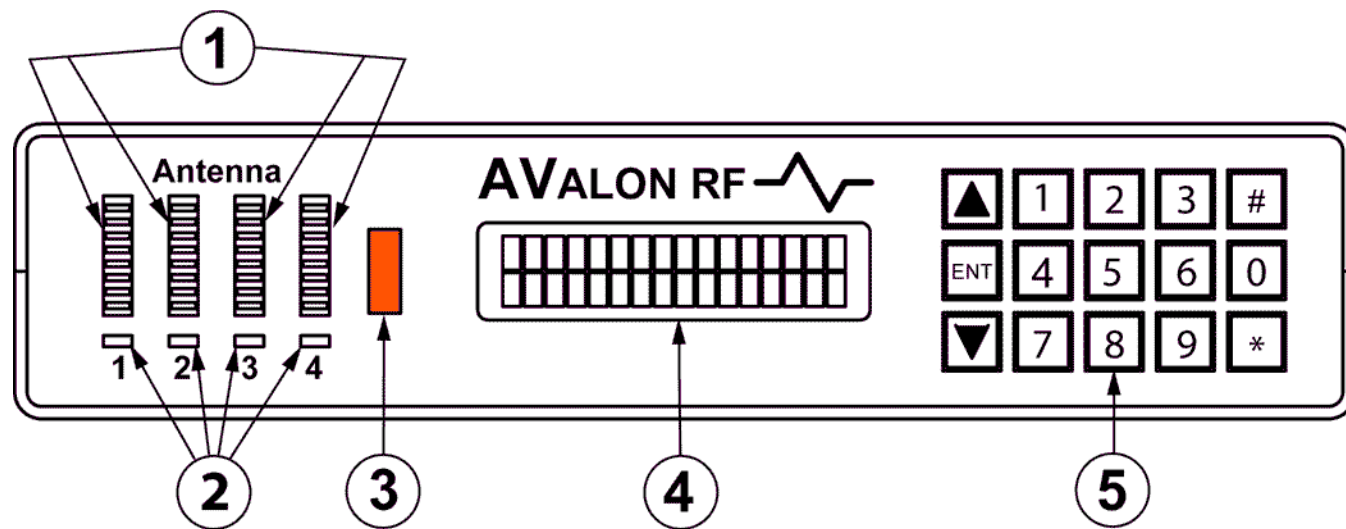
Figure A – Front Panel
DX404/DX504/DX604 Controls, Indicators and Connectors

1 Signal Quality Indicators

2 Antenna Select LED

3 IRDT Receiver

4 LCD Display

5 Keypad
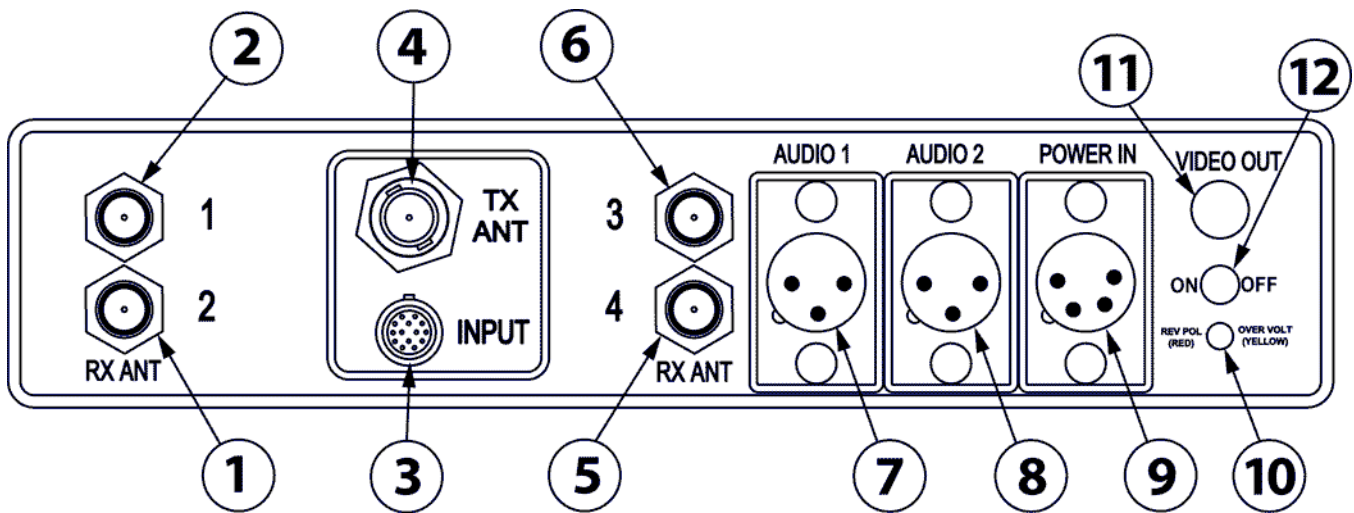
Figure B – Rear Panel
DX404/DX504/DX604 Controls, Indicators and Connectors

1, 2, 5, 6	Antenna Inputs (Section 2.2)
3	Digital Wireless Link Data Input (section 2.5)
4	Digital wireless link Antenna Output (section 2.6)
7, 8	Audio Outputs (section 2.4)
9	Power & RS232 Input (Section 2.1)
10	Power Fault Indicator
11	Video Output (Section 2.3)
12	On/Off Switch

2.   Specifications

2.1   Power Input (Circle 9 on rear panel).

a) The power input connector is a XLR 4 pin on the rear panel of the DX604.

Pin 1 – Ground

Pin 2 – RS232 Interface (Transmit)

Pin 3 – RS232 Interface (Receive)

Pin 4 - +9Vdc to +16Vdc
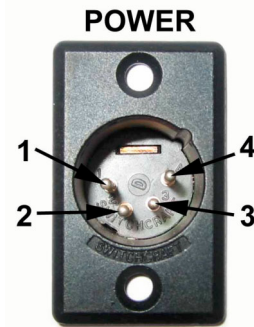
Figure C – Power Input

b) The DX604 operates off a 9Vdc to 16Vdc unregulated voltage source with a ripple of less than 0.5Vp.p.

c) Input Current at an input voltage of 12Vdc is under 1 Amp.

d) Power is switched via an ON/OFF mechanical switch.

e) The DX604 power input is protected against over voltage and reverse polarity.

A bi-color LED on the rear panel indicates the condition. Yellow indicates over voltage and Red indicates reverse polarity.

NOTE

f) The RS232 interface option on pins 2 and 3 is used to remotely program and setup the DX604 as described in Appendix B.

2.2   Antenna Inputs, total of 4 (Circles 1,2,5,6 on rear panel).

a) DX404: The tuning frequency range is 56MHz-802/860MHz, VSB modulated. The antenna connectors of the NTSC model are "F" type with a 75 Ω (ohm) impedance. The PAL model has RCA connectors.

b) DX504: The tuning frequency range is 900-2150 MHz, FM modulated. The antenna connectors are "F" type with a 75 Ω (ohm) impedance.

c) DX604: The tuning frequency range is 2350-2500 MHz, FM modulated. The antenna connectors are SMA type with a 50 Ω (ohm) impedance.

2.3   Video Output (circle 11 on rear panel)

The video output through a 75 Ω (ohm) BNC connector.

a) Output is NTSC/PAL/RS170A/CCIR baseband from 20 Hz to 5.5 MHz in broadcast mode and 20 HZ to 4.0 MHz in reference mode.

b) Output amplitude is 1 Vp.p. with negative sync tips of 0.3 Vp.p.

2.4   Audio Outputs (Circles 7,8 on rear panel)

Both audio outputs are XLR 3 pin connectors located on the rear panel.

Audio 1 or 2

Pin 1 – Ground

Pin 2 – Audio Output (P)

Pin 3 – Audio Output (N)
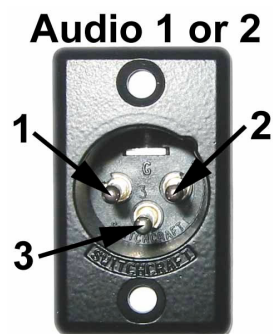
Figure D – Audio Output(s)

Output is 1 V (peak to peak) into 600 Ω (ohm), balanced.

2.5   Digital Wireless Link Data Input.

The digital wireless link input connector is a LEMO type
ECG.1B.3147.CLL or equivalent:

The connector pin-out is:

LEMO ECG.1B.314.CLL or Equivalent

Pin		Pin	
1	Speaker Left	8	Telemetry 1
2	Microphone	9	Telemetry 2
3	Speaker Right	10	Telemetry 3
4	Microphone Bias	11	Ground
5	RS485 I/O "A"	12	Ground
6	RS485 I/O "B"	13	N/C
7	Alarm	14	N/C
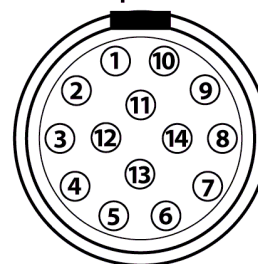
Figure E – Digital Wireless Link Data Input

2.6   Digital Wireless Link Antenna Output

The antenna output is a BNC antenna with 50 Ω (ohm) impedance.

2.7   Size

The DX404/DX504/DX604 are available in two configurations:

Configuration	Dimensions
Single DX604 (See Figure F)	Without Removable Hood 8.5" W x 1.75" H x 12.125" D 216mm x 45mm x 308mm
	With Removable Hood 8.7" W x 1.9" H x 13.1" D 221mm x 48mm x 333mm
Dual DX604 (Option R) (See Figure G)	17" W x 1.75" H x 12.125" D 432mm x 44.5mm x 308mm

NOTES

The DX604 is intended for use in a desktop configuration.

The dual DX604 is intended for mounting in a RETMA 19" rack and requires a height of 1U.

2.8   Weight

Description	Dual (Option R) Desktop (single)	Rack mount
Net	4.3 lbs (1.90Kg)	8.5 lbs (3.80Kg)
Shipping weight	8.5 lbs (3.80Kg)	17 lbs (7.6Kg)
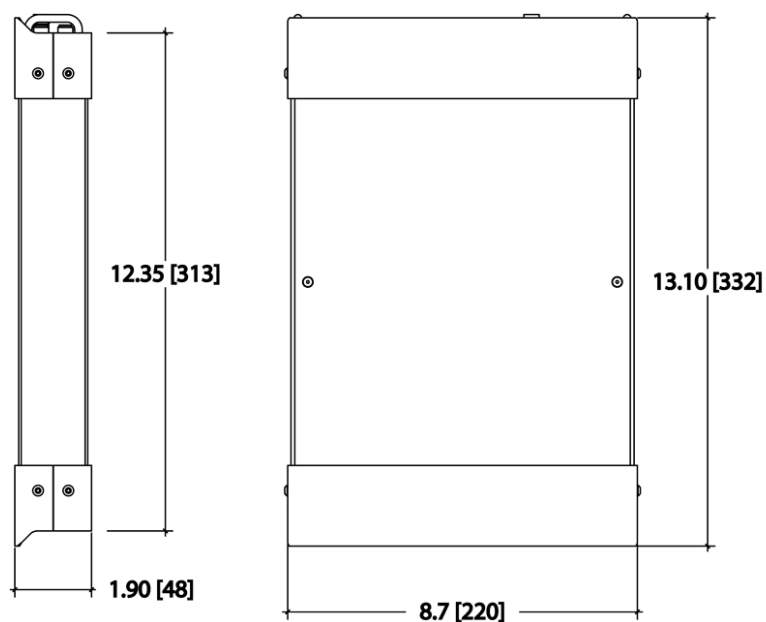
**Figure F – DX604 Mechanical Specifications
Inches [mm]**
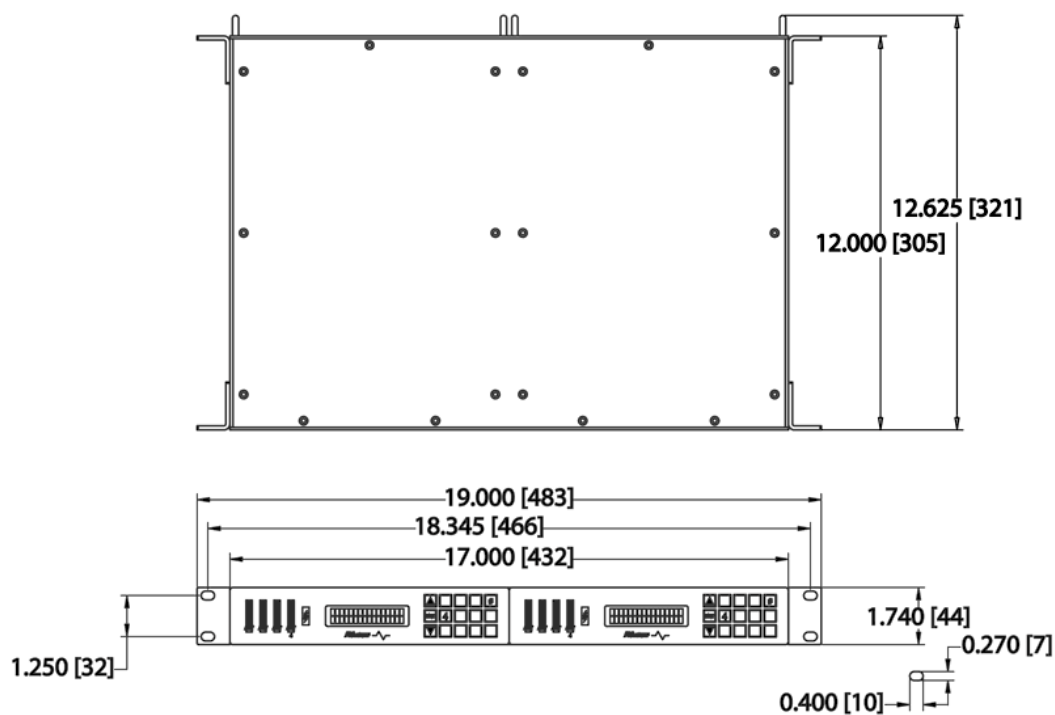
**Figure G – DX604 (Option R) Mechanical Specifications
Inches [mm]**

2.9   **Environmental Conditions.**

The DX604 is designed to meet the following environmental conditions:

a)   Operating temperature   -4° to 122° F
                                 (-20° to 50° C)

b)   Storage temperature   -13° to 150° F
                                 (-25° to 65° C)

c)   Vibration   1.5G, from 10Hz to 2KHz, sine wave, three axis

d)   Shock   15G, 25msec, half sine wave, three axis

e)   Humidity   5 to 95%, non-condensing

f)   Inclination   Any

g)   Altitude   -1500 feet to 15,000 feet
                                 (-450 meter to 4,500 meter)

3.   Operating Instructions

3.1 **Human Interface.**

3.1.1 Front Panel Keypad (Circle 5 on figure A)

All manual setup functions are entered via the keypad.
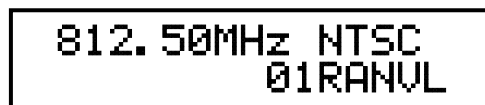
3.1.2 Front Panel Indicators (Circles 1,2 on figure A).

The DX604 front panel includes the following indicators:

a)   Signal quality indicators for each antenna via an 8 segment LED
     bar graph. The higher the illuminated LED, the better the signal
     from the antenna.

b)   Antenna select LED. One Green LED for each antenna. The
     antenna LED indicates which of the antennas has been selected
     for its best video.
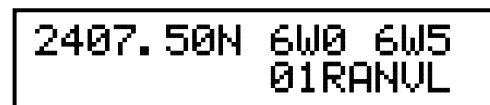
3.1.3 Front Panel Display (circle 4 on figure A)

The DX604 has a 2 line LCD display, each line capable of displaying
up to 16 alphanumeric characters.

```
┌─────────────────────┐        ┌─────────────────────┐
│ 812.50MHz NTSC      │        │ 2407.50N 6W0 6W5    │
│         01RANVL     │        │         01RANVL     │
└─────────────────────┘        └─────────────────────┘
```
Typical DX404 display   **Typical DX504/DX604 display**

The top line of the LCD displays the frequencies of the video carrier
and (on the DX504/DX604 only) of the two audio sub-carriers. The
format of the second line is explained in Appendix A.

The display can be turned ON or OFF (see section 3.2.4).

3.1.4 Front Panel Interface

The DX604 has an optional IRDT serial interface, capable of
communicating with a PDA at a distance up to 3 feet.

3.2 **Operating the DX604.**

The commonly used receiver commands are:
* Tuning
* Frequency scanning
* Tuner select (Excluding tuners from the diversity)
* Turning the display on or off
* Locking the keypad.

3.2.1 Tuning

<FREQ> <ENTER> tunes in to the desired frequency. The <*> key is used as a decimal point.

The DX404 NTSC model tuning range is from 56MHz to 802.25MHz
The DX404 PAL model tuning range is from 56MHz to 860MHz.
The DX504 tuning range is from 900 MHz to 2150 MHz.
The DX604 tuning range is from 2350 MHz to 2500 MHz.

E.G.:
802*25<ENTER> tunes a DX404 to 802.25MHz (Channel 69)
912<ENTER> tunes a DX504 to 912MHz.
2412<ENTER> tunes a DX604 to 2.412GHz.

The tuned-in frequency appears on the top left of the LCD as explained in Appendix A.

If <FREQ> is out of the tuning range, the receiver will display "INVALID" and default to the last tuned-in frequency.

E.G.:
912<ENTER> is beyond the tuning range of the DX604 and will be rejected.

#<CHANNEL> <ENTER> tunes in to the desired channel (DX404 only).

The valid channels for the DX404 NTSC model are 2-69.
The valid channels for the DX404 PAL model are 2-12 and 21-70.

E.G.:
#25<ENTER> tunes a DX404 to channel 25.

3.2.2 Frequency scanning.

<UP> tunes to the next higher frequency.
<DOWN> tunes to the next lower frequency.
Holding down the <UP> or <DOWN> keys changes the frequency
repeatedly.

The factory preset step increment/decrement step is 0.25MHz and
may be changed by typing the following sequence:

*92 <STEP> <ENTER>

Where
<STEP> is a 4 digit number from 0025 to 9975, corresponding to
a minimum step of 0.25MHz and a maximum of 99.75MHz.

E.G.:
*92 1 <ENTER> will increment/decrement 1MHz at a time.
*92 12 <ENTER> will increment/decrement 12MHz at a time.
*92 0025 <ENTER> will increment/decrement 0.25MHz at a time.
*92 1225 <ENTER> will increment/decrement 12.25MHz at a time.

3.2.3 Tuner Select

The DX604 is factory preset to automatically select one of the 4
tuners (The one with the best signal). The number of tuners
participating in the diversity process can be limited via the following
function (<TN> is any tuner number from 1 to 4):

*1# <TN> <ENTER> selects one tuner only.
*1# <TN> <TN> <ENTER> selects two tuners.
*1# <TN> <TN> <TN> <ENTER> selects three tuners out of four.
*1 <ENTER> selects all four tuners (normal mode)

E.G.:
*1#1 <ENTER> locks the output to tuner 1 and stops the diversity.
*1#12 <ENTER> eliminates tuners 3 and 4 from the diversity
*1#123 <ENTER> eliminates tuner 4 from the diversity
*1 <ENTER> includes all four tuners in the diversity process.

A A/M indication is shown on the LCD display, line 2 as explained in
Appendix A. This setting is not saved at power off.

3.2.4 Turning ON or OFF the display.

*# <ENTER> toggles the display ON or OFF.

3.2.5 Locking the keypad.

This feature is used to prevent accidental change of setup.

*077 <ENTER> locks the keypad.
*055 <ENTER> unlocks the keypad.

The LCD displays a "L" at the bottom right if the keypad is locked.

3.3   Setup.

3.3.1 Tuning the audio sub-carrier frequencies (DX504/DX604 only).

The Audio1 sub-carrier frequency is factory preset to 6 MHz.
The Audio2 sub-carrier frequency is factory preset to 6.5MHz.

The audio sub-carrier frequencies can be tuned anywhere between 5MHz to 7MHz in increments of 10KHz.

Audio1: *21# <FREQ> <ENTER>
Audio2: *22# <FREQ> <ENTER>

Where <FREQ> is from 500 to 700 (the first digit represents megahertz & the last digit represents 10's of kilohertz), tunes the audio sub-carrier to the desired frequency. If the '#' character and <FREQ> are omitted, the sub-carriers will tune to the factory preset.

E.G.:
*21# 665 <ENTER> tunes Audio1 to 6.65 MHz.
*22# 700 <ENTER> tunes Audio2 to 7MHz
*22 <ENTER> tunes Audio2 back to 6.5MHz

3.3.2 Setting the audio sub-carrier bandwidth.

The audio IF bandwidth can be set to **narrow** for 75 KHz deviation or **wide** for 125 KHz deviation.

Audio1: *211 <ENTER> sets Audio1 bandwidth to Narrow.
        *210 <ENTER> sets Audio1 bandwidth to Wide.
Audio2: *221 <ENTER> sets Audio2 bandwidth to Narrow.
        *220 <ENTER> sets Audio2 bandwidth to Wide.

Selecting an incorrect audio bandwidth results in a low and distorted audio output.

3.3.3 Changing the video bandwidth (DX504 only).

The DX404 video bandwidth is factory preset to 5MHz. The DX604 video bandwidth is factory preset to 16 MHz. The DX504 video bandwidth can be field changed from 16MHz to 27 MHz and back.

*32 <ENTER> changes the video bandwidth to 27 MHz.
*31 <ENTER> changes the video bandwidth to 16 MHz.

LCD display indication – first line, after carrier frequency.
"W" alongside the carrier frequency indicates **wide** bandwidth of
27 MHz. "N" indicates **narrow** bandwidth of 16 MHz.

3.3.4 Inverting the polarity of the video output.

The DX604 is factory preset to positive video (negative sync).

*42 <ENTER> sets the video output to negative video.
*41 <ENTER> restores video output to positive video.

LCD display indication – second line (See Appendix A)
"N" indicates NORMAL (positive) video. "I" indicates INVERTED
(negative) video.

3.3.5 Adding the audio sub-carriers to the video output (DX504/DX604
only).

This function extends the diversity architecture above the 4 inputs
available on a single DX504/DX604 to 8, 12, and 16 inputs by
hooking up two, three or four DX504/DX604 receivers to a DX004
baseband diversity receiver.

*51 <ENTER> sets the video output to video with no audio.
*52 <ENTER> sets the video output to video with audio.

LCD display indication – second line (See Appendix A)
"V" indicates video with no audio.
"R" indicates video with audio.

NOTE

Displaying video that has the audio subcarriers on it will show visible
noise on the picture.

3.3.6 Assigning an EIN (Electronic Identification Number) to the DX604.

This command is used in conjunction with the IRDT option.

Every DX604's EIN is factory preset to "01".

The EIN allows control of multiple DX604s from a single remote control.

*9# <EIN> <ENTER> where <EIN> is a number from 01 to 99 assigns EIN as the receiver ID.

4.   Error conditions and Prompts.

4.1   Power fault indicator.

The power fault indicator (Circle 10 on the rear panel) illuminates when the input voltage exceeds 17V, or when the input voltage is hooked up in reverse polarity.

4.2   Battery-low warning.

The front panel LCD backlight will blink whenever the power input voltage drops below 10.5V. While in this mode, the receiver is unable to memorize any setup changes.

LCD display indication – second line (See Appendix A)
The LCD will display a "LO BATT" warning message.

4.3   Internal errors.

The LCD messages "ERR: MEM" and "ERR: I2C" indicate internal errors. The DX604 will need to be serviced. Please call your dealer or AValon RF directly.

The message "ERR: <KEY NAME>KEY" indicates one of the keypad keys is stuck. The DX604 may need to be serviced.

4.4   Unlocked tuners.

When the DX604 tuners cannot lock the internal LO, the message "ERR: <TUNER #>UL" will be displayed. E.G. if tuner 2 cannot lock, the message "ERR:2 UL" will be displayed. If more than one tuner is unlocked, only one number is displayed.

4.5   Keypad entry errors.

When an illegal command or a command with illegal parameters is entered, the message "INVLD" is displayed. See description for specific commands.

5.   Ordering Information

DX404 – Basic System
DX504 – Basic System
DX604 – Basic System

Every DX604 comes with the following standard features and accessories.

5.1.1 One DX404 or DX504 or DX604 in a ZIPLOCK ESD bag.

The receiver has one video and two audio channels.

5.1.2 One BX002U 12V low noise regulated AC adapter for 110Vac/60Hz.

5.1.3 A user manual (the one you're reading).

5.1.4 A warranty card.

5.1.5 One reusable carton with foam lining.

5.2   **Optional features:**

Option 00   European version.
                   Includes a 230VAC power adapter and calibration
                   for PAL.

Option 01   Remote programming.
                   Includes the IRDT and RS232 interface on the
                   power input connector. Consult Appendix B for
                   programming instructions.

Option 02   Remote synthesizing (DX604 only)
                   This option automatically changes the operating
                   frequency of a TX630 companion transmitter to
                   match the change in tuning frequency of its DX604.
                   It requires Option 11.

Option 03   Dual IF bandwidth (DX504 only)
                   IF bandwidth of 16MHz and 27MHz

Option 04   Extended tuning range (DX604 only)
                   2.150GHz to 2.500GHz

Option 11   Two way serial communication channel.

Option 21E   VITC/SMPTE time stamp
                   Adds VITC/SMPTE time stamp when used with
                   transmitters not supplied by Avalon RF.

Option 31   Audio talk back
                   Does not work in conjunction with option 11

Option 41   Alarm output

Option 51   Telemetry output.

Option 99   Power to an external LNA

Option R   Rack mount adapter (requires two receivers).

5.3 **Optional accessories**

5.3.1 **Antennas.**

Each receiver requires four (4) antennas. Higher antenna gain yields longer range with limitations on reception "viewing angle".

Ordering information:

Description		DX404	DX504	DX604
2dbi	omnidirectional	AX402	AX502	AX602
2dbi	omni circular polarized			AX602R
5dbi	omnidirectional	AX405	AX505	AX605
6dbi	hemispheric patch	AX406	AX506	
9.5dbi	panel antenna			AX609
10dbi	circular polarized(RH) patch			AX610R
10dbi	circular polarized(LH) patch			AX610L
11dbi	log periodic antenna	AX411		
13dbi	panel antenna		AX513	AX613
15dbi	panel antenna			AX615
18dbi	panel antenna			AX618
24dbi	parabolic antenna			AX624

5.3.2 **Antenna cables.**

These cables connect the receiver to its antennas. If a system requires splitters, these cables connect the antennas to the splitters.

DX604: Times Microwave LMR-240 50 Ω (ohm) or equivalent are recommended for runs up to 30ft and LMR-400 50 Ω (ohm) for runs from 20ft to 50ft.

Ordering Information:

Length	DX404/DX504 F-F/75Ω (ohm)	DX604 N-SMA/50Ω (ohm)
5'	CBLFF-5	CBLNS-5
15'	CBLFF-15	CBLNS-15
30'	CBLFF-30	CBLNS-30
50'	CBLFF-50	CBLNS-50

5.3.3 Antenna cables for the Digital Wireless Link (DWL)

The DWL antenna cable is a BNC to BNC cable with RG58 cable.

5.3.4 Splitters

When a set of four antennas feeds more than one receiver, it is convenient to split the signal from each antenna to all receivers at the same location.

There are two types of splitters: Passive and amplified. Passive are lower cost and adequate for short range. Amplified splitters are costly but offer better sensitivity.

Ordering information:

Splitter type	DX404/DX504 (F-F)	DX604 (SMA-SMA)
1 to 2 (two DX..4)	SP2F	SP2S
1 to 3 (three DX..4)	SP3F	SP3S
1 to 4 (four DX..4)	SP4F	SP3S
1 to 8 (eight DX..4)	SP8F	SP8S

5.3.5 Combined LNA, switches, splitter and data channel combiner.

Avalon RF offers the SP8/4, an eight antenna input unit that combines eight LNA (One per antenna), Four RF MMIC switches that drive four 1 to 4 broadband splitters.

The SP8-4 also includes a four input RF combiner for the data communication channel.

Ordering information:

|	
UHF or 900MHz	SP8/4FF
2.4GHz	SP8/4SS

5.3.6 **Splitter to receiver cables.**

The use of splitters requires jumper cables from every splitter output to every receiver antenna input. For a four receiver

Ordering information:

Number of DX..4 Receivers	Number of cables	DX404/DX504	DX604
2	8	CBLFF-2	CBLSS-2
3	12	CBLFF-2	CBLSS-2
4	16	CBLFF-2	CBLSS-2

5.3.7 **Digital Wireless Link (DWL) combiner cables.**

A RF signal combiner feeds one DWL antenna and antenna cable from is used to drive the DWL signals from more than one DX..4 receiver to a single DWL antenna and antenna cable.
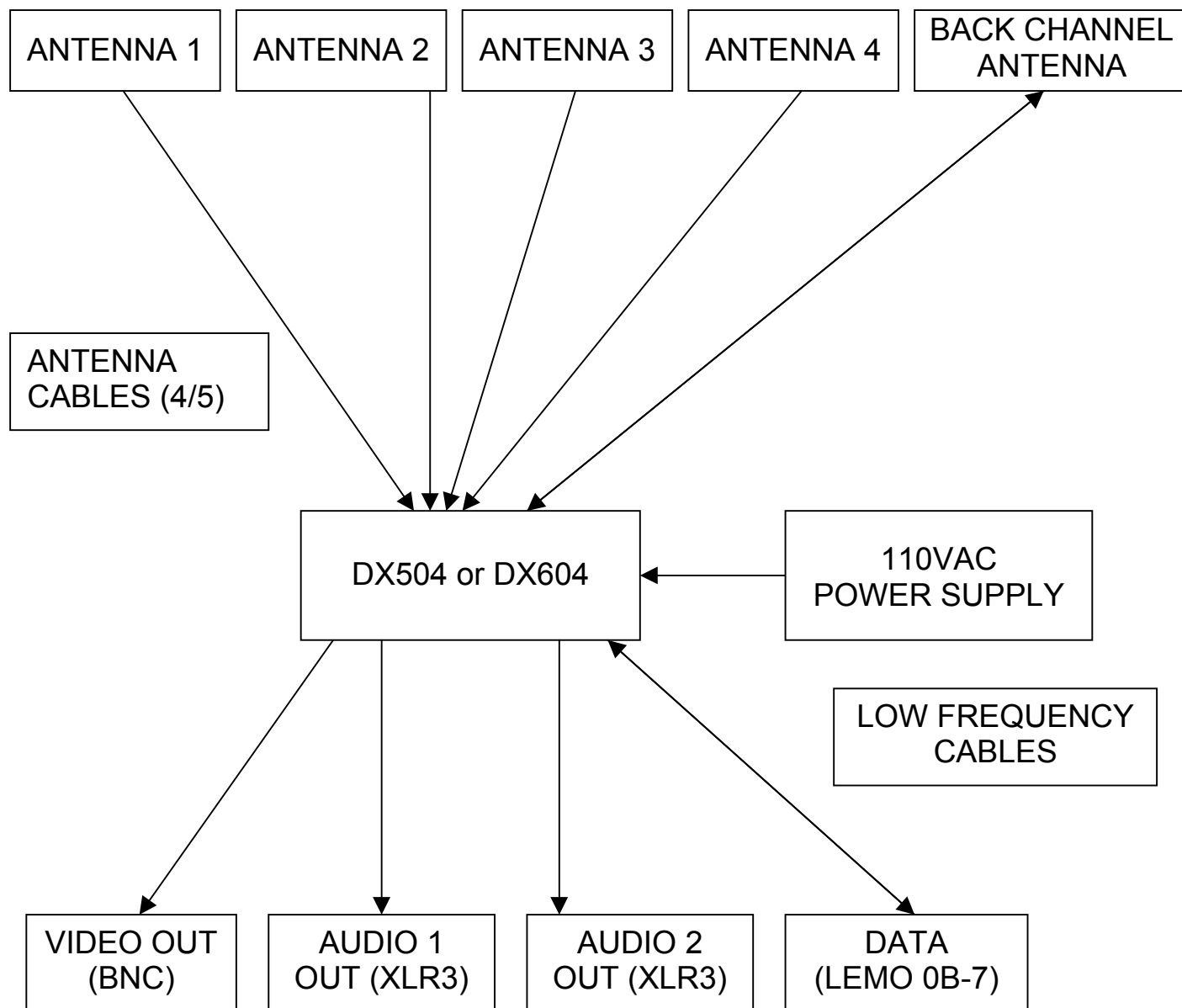
Figure H – Block Diagram of Basic System with a Single DX404/DX504/DX604 Receiver
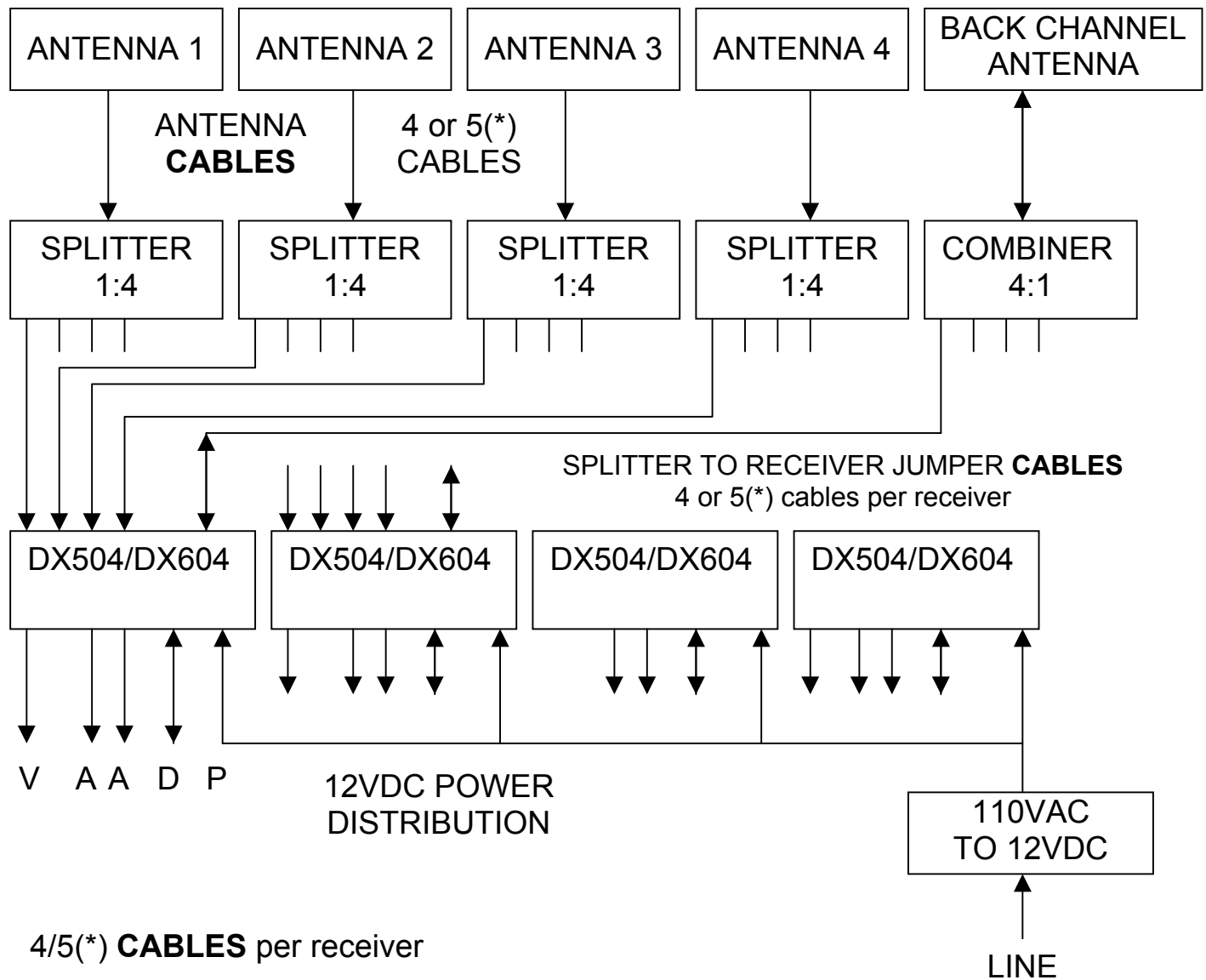
**Figure J – Block Diagram of System with
Four DX404/DX504/DX604 Receivers**

Appendix A – LCD format

```
FFFF.FFMHz SSSS
MMMMMMMM NNRAIVL
```
←——— First line
←——— Second line

DX404 LCD format

```
FFFF.FFn aAa bBb
MMMMMMMM NNRAIVL
```
←——— First line
←——— Second line

DX504/DX604 LCD format

A.1 The format of the first line is:

FFFF.FF is the carrier frequency

SSSS (DX404 only) is the video standard (PAL or NTSC).

n (DX504 only) is the video bandwidth: N = 16MHz
                                                    W = 27MHz

aAa (DX504/DX604 only) is the audio1 sub-carrier frequency
bBb (DX504/DX604 only) is the audio2 sub-carrier frequency

Where **A** and **B** indicate the sub-carrier bandwidth: N=75KHZ
                                                           W=150KHz

A.2   The format of the second line is:

MMMMMMMM is a warning prompt: INVLD =   wrong entry
                                                   ERR =   system check
                                                                        MEM, I2C,KEY

NN is the receiver EIN (For the Optional IRDT remote control)

R is a single letter notifying: "P" Program mode, "R" Receive mode

A is a single letter notifying: "A" Automatic mode, "M" Manual mode

I is a single letter notifying: "N" = positive video, "I" negative video

V is a single letter notifying: "V" = video, "R" = video + audio

L is a single letter indicating that the keypad is locked

Appendix B – Remote Programming Option

The DX404/DX504/DX604 can be remotely programmed via a:

- RS232C interface

  The data rate is set for 9600 Baud, 8 bits, no parity, 1 stop bit and no handshaking signals.

- An IRDT interface (Figure A - circle 3)

B.1   Enabling the remote programming option.

On receipt of the 'lock keypad' command (<*077>), the DX604 enters the 'Remote/Programming' mode and the front panel keypad is 'locked'. The second line of the front panel LCD will display as follows:

```
2407.50N 6W0 6W5
        01PANVL
```

The **P** indicating the 'Remote or Programming' mode and the **L** indicating the locked keypad. To bring the unit back to front panel operation, use the keypad unlock command.

B.2   Commands and responses

Commands sent to the DX604 should be terminated by the "carriage return" (0Dh) character, the "line feed" (0Ah) character, or the "carriage return" + "line feed" sequence.

If the command sent is valid, it will be executed and the new content of the LCD display is sent to the RS232C or IRDT interface, terminated by a carriage return + line feed. If the command is not valid, the sequence 'Error' is sent back.

B.3   List of Commands

a)   Frequency tuning: <FREQ><CR>

b)   Channel tuning: #<FREQ><CR>

c)   Frequency scanning step size: *92<STEP><CR>

d)   Tuner Select: *1# <TN><CR> (1 or more tuners)

e)   Turning ON or OFF the display: *#<CR>

f)   Unlocking the keypad: *055<CR>

g)   Tuning the audio sub-carrier frequencies (DX504/DX604 only):
       Audio1:   *21# <FREQ><CR>
       Audio2:   *22# <FREQ><CR>

h)   Setting the audio sub-carrier bandwidth:
       Audio1: *211<CR> sets Audio1 bandwidth to Narrow.
              *210<CR> sets Audio1 bandwidth to Wide.
       Audio2: *221<CR> sets Audio2 bandwidth to Narrow.
              *220<CR> sets Audio2 bandwidth to Wide.

i)   Changing the video bandwidth (DX504 only):
       *32<CR> changes the video bandwidth to 27 MHz.
       *31<CR> changes the video bandwidth to 16 MHz.

j)   Inverting the polarity of the video output:
       *42<CR> sets the video output to negative video.
       *41<CR> restores video output to positive video.

k)   Adding audio sub-carriers to the video output (DX504/DX604 only):
       *51<CR> sets the video output to video with no audio.
       *52<CR> sets the video output to video with audio.

l)   Assigning an EIN (Electronic Identification Number):
       *9#<EIN><CR>